SAGE III Status

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Overview

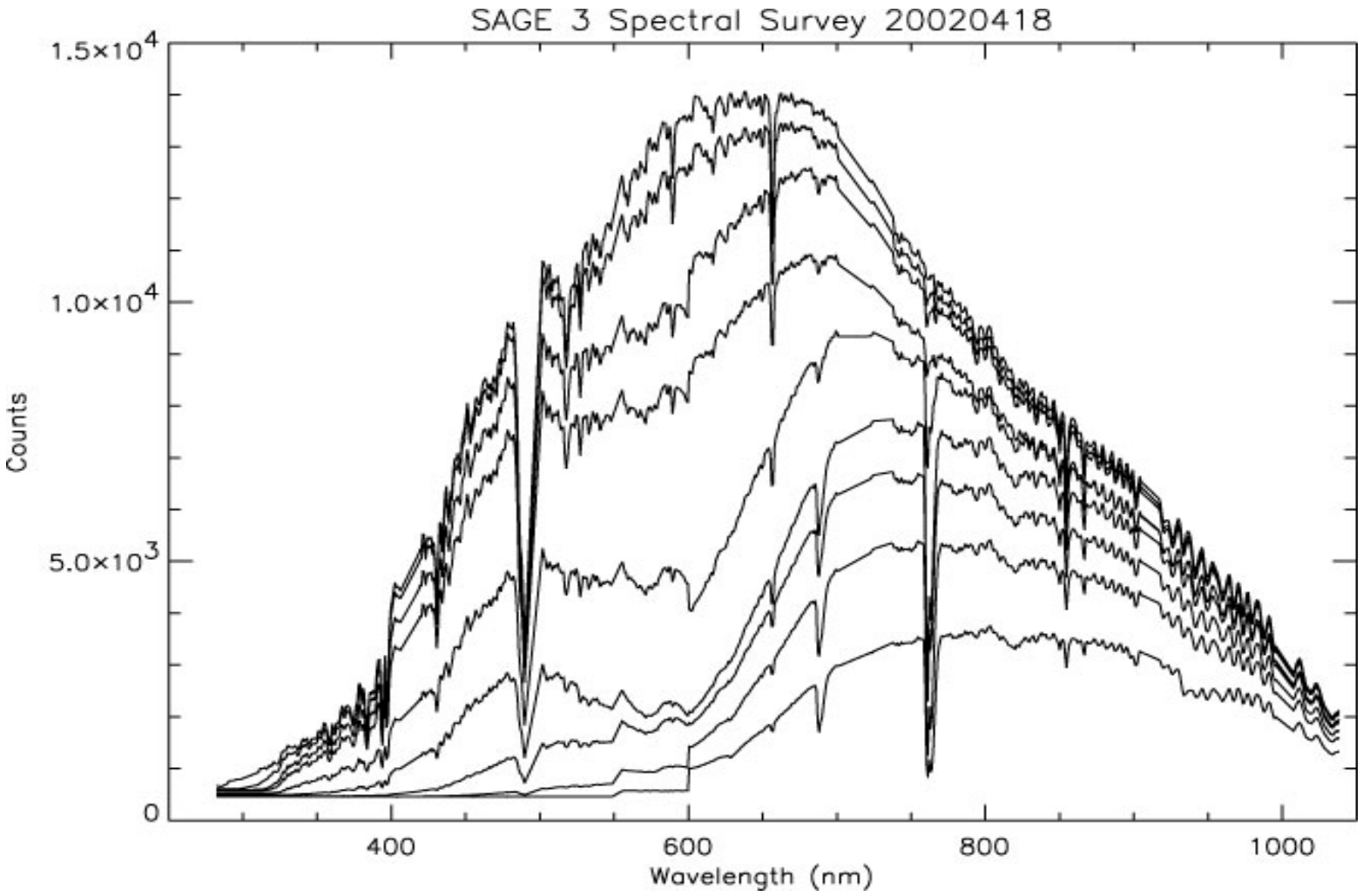
Mission Milestones

Launch:	December 10, 2001
SAGE III Power ON:	December 17, 2001
First Data Transmission to WFF:	December 19, 2001
1.7 GHz Transmitter anomaly:	January 1, 2002
Resume operations:	February 18, 2002
First Solar Measurements:	February 27, 2002
First Lunar Measurements:	March 4, 2002
First ILRS Orbit Products:	May 7, 2002
First Limb Scan Measurement:	June 30, 2002

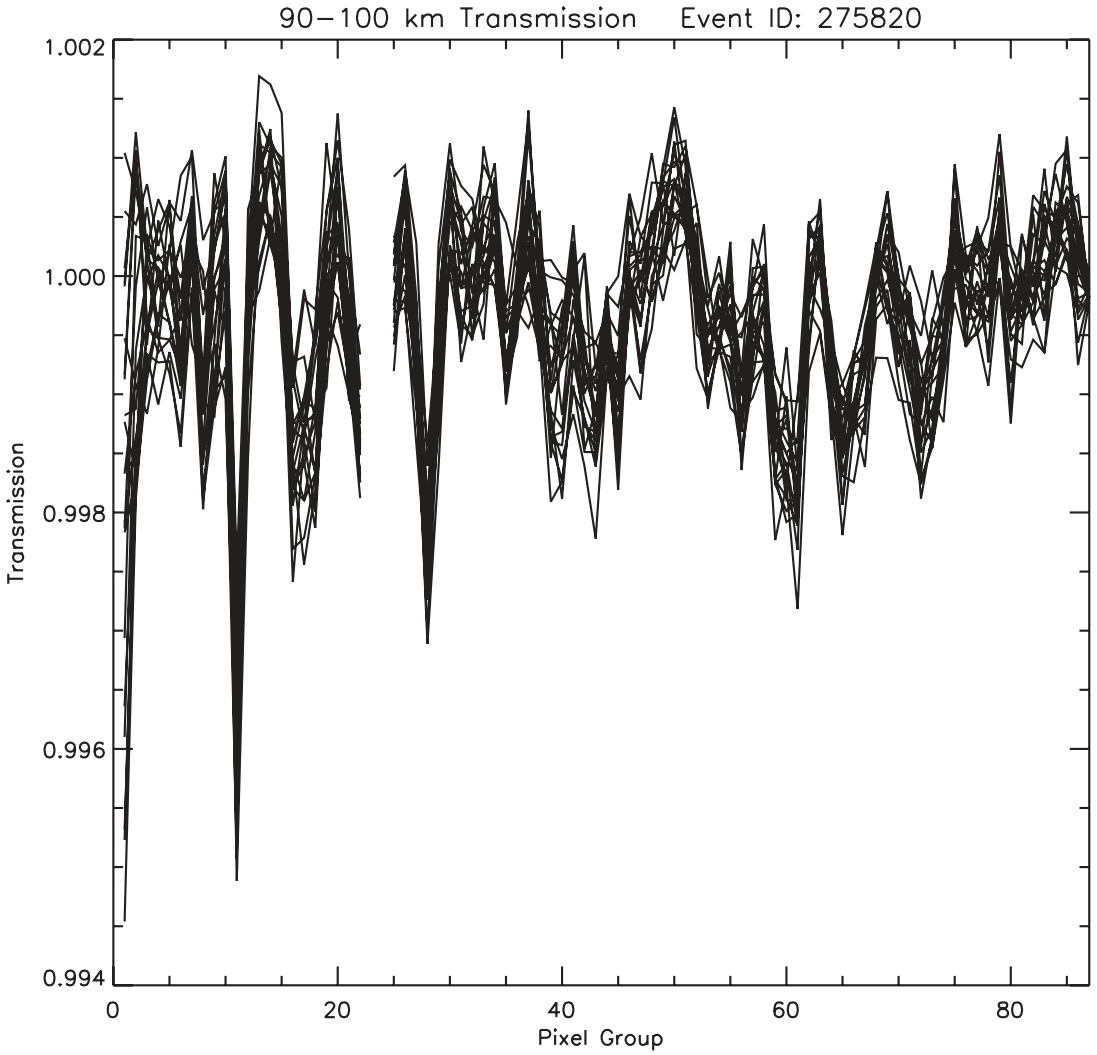
SAGE III Data Status

- Solar data are routinely processed since May 7, 2002
- Solar ozone, NO_2, and aerosol is routinely released and available at Langley's ASDC
- Pre May 7, 2002 data are being evaluated for processing and release
- A total of approximately 700 events of lunar measurements since April 2002 has been collected and processed for possible released in the near future

SAGE III Instrument Performance

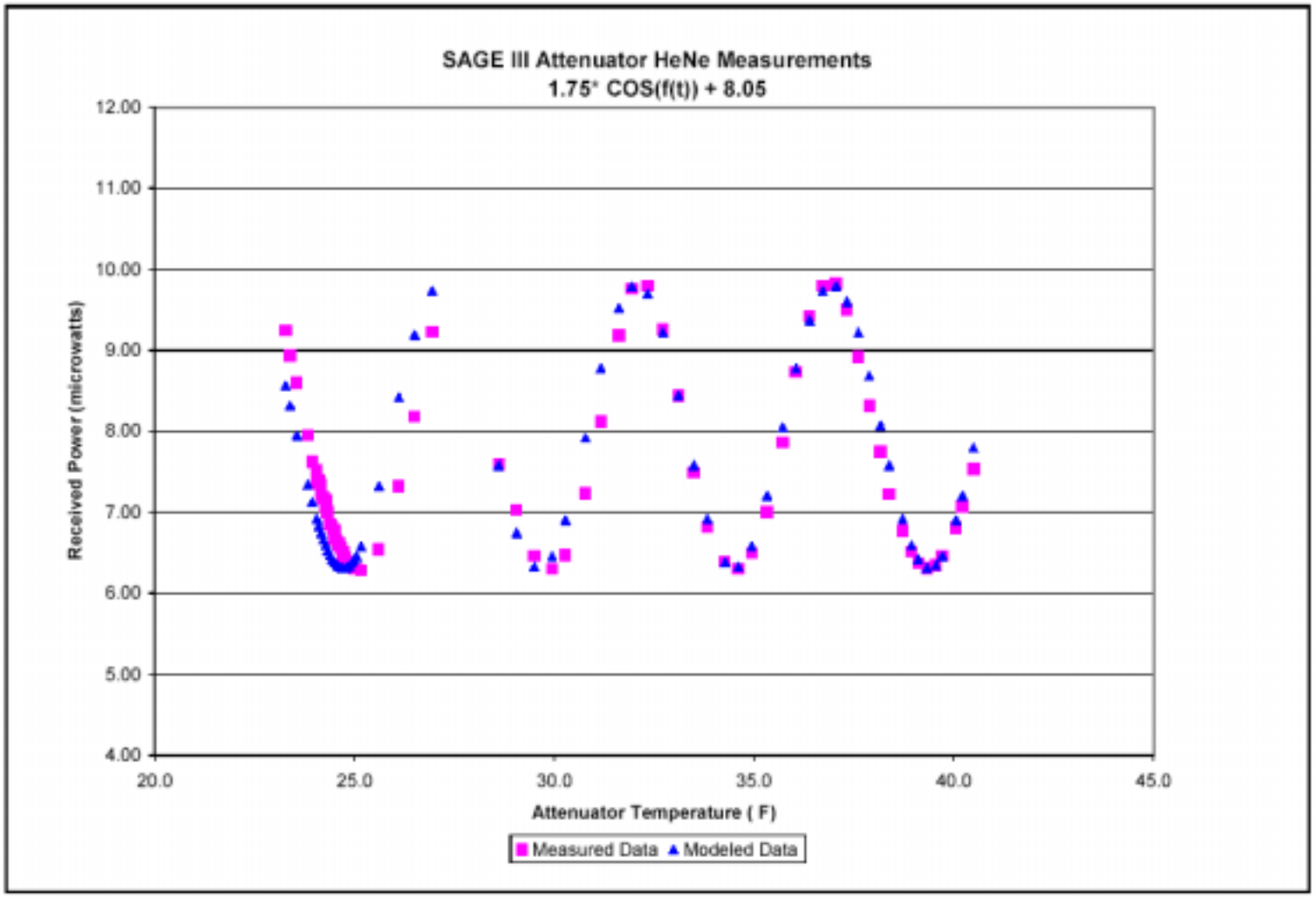


Anomalous Spectral Features



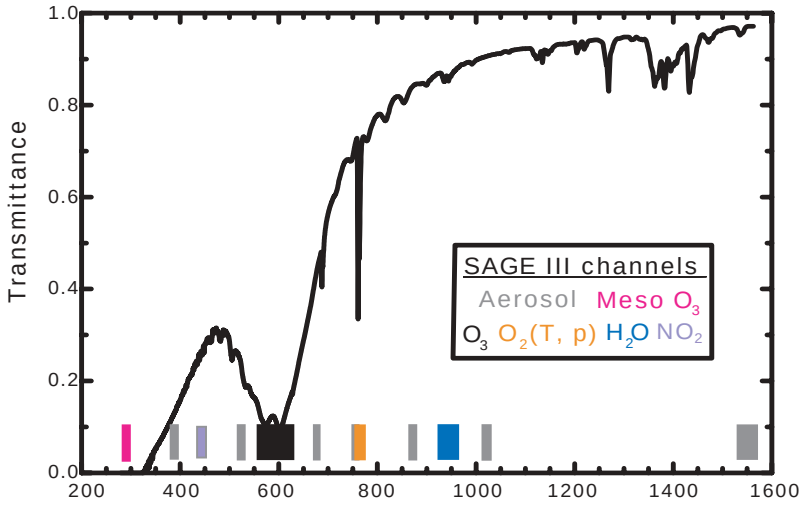
High altitude transmission exhibits anomalous but consistent spectral features

Etaloning from the Attenuator Plate



Solar Channel Map

Channel	Wavelength (nm)	Subchannels	Species
S1	287.2-292.9	1	Mesospheric O_3
S2	381.9-386.6	1	Aerosol
S3	432.6-450.4	19	NO_2, Aerosol
S4	518.0-522.7	1	Aerosol
S5	560.2-622.5	10	O_3
S6	673.3-678.0	1	Aerosol
S7	753.1-757.8	1	Aerosol
S8	757.8-770.9	14	T/P
S9	867.0-871.1	1	Aerosol
S10	933.0-959.9	29	H_2O
S11	1018.9-1024.5	1	Aerosol
S12	1530.1-1560.2	1	Aerosol



Change in CCD Channel Map Configuration

Solar Measurements

- Relocate 2 pixels in 940 nm water vapor region to 920 nm and 971 nm.
- Addition of two channels at 286 and 294 nm for mesospheric ozone

Change In CCD Channel Map Configuration

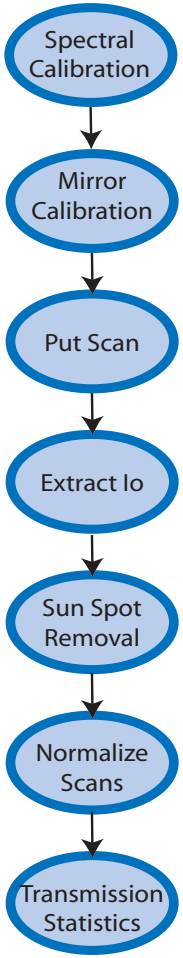
Lunar

- Remove the 20 pixel 940nm water vapor channels
- Change oxygen A-band to single pixel resolution
- Addition of the oxygen B band measurement

SAGE III Algorithm

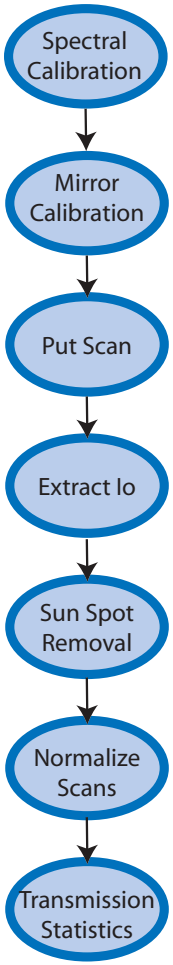
A brief discussion

Transmission Flow



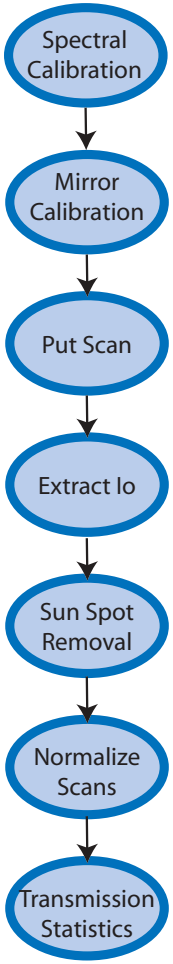
- Determines measurement location in tangent altitude and position on Sun
- Corrects for mirror reflectivity variation with angle
- Identifies and tags sunspots
- Normalizes data with I_o values
- Groups transmission by altitude and computes a transmission profiles and statistics.

Spectral Calibration



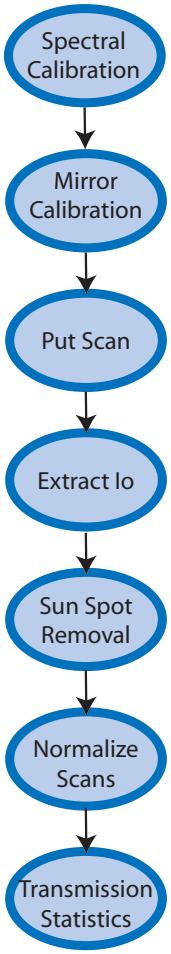
- Original spectral calibration was run showing no significant change in wavelength registration from event to event.
- Current data processing uses a fixed wavelength calibration based on pre-launch ground-test spectral calibration

Mirror Calibration & Extract I_o



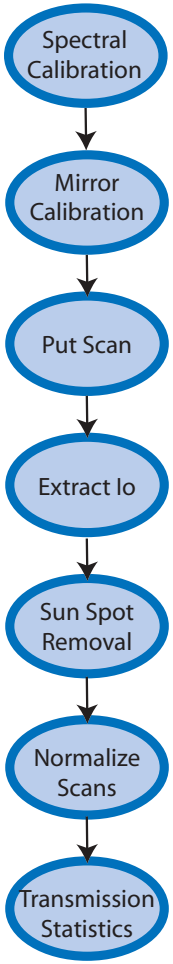
- Mirror Calibration
  - Designed to measure the changes in mirror reflectivity as a function of angle
  - Current mirror calibration is performed per event basic using exoatmospheric data
  - Mirror calibration is performed at the data packet level together with the estimation of basic functions (EOF) describing the etaloning noise

Scan-based Processes

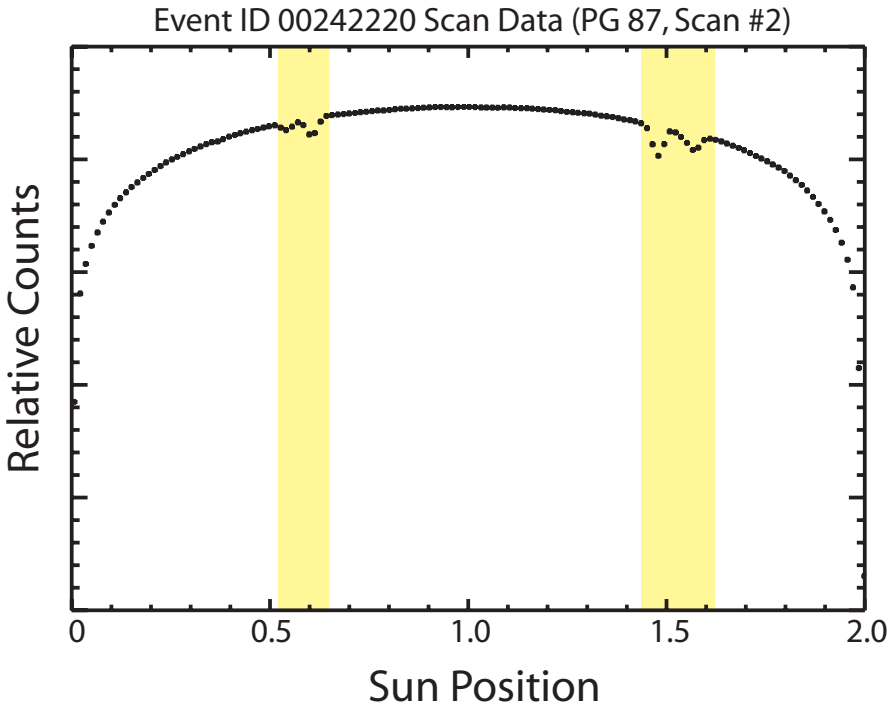


- Algorithm
  - Background subtraction
  - Sun edge detection
  - Altitude registration
  - Sun location
- Approach
  - Transmission noise was reduced by transitioning SAGE II tools (Version 6 stretch and shift) that improved scan-to-scan registration, scan rate, and the identification and processing of scans for which the bottom edge of the Sun when it is obscured

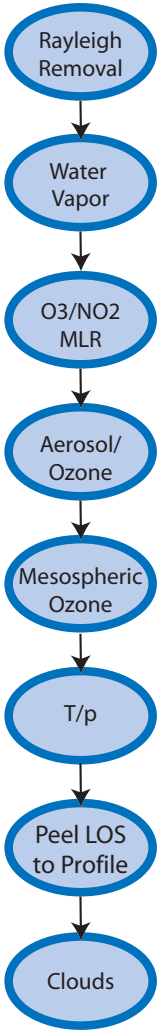
Sun Spot Removal



- Regions identified as having a sunspot are marked and excluded from use in transmission and level 2 processing

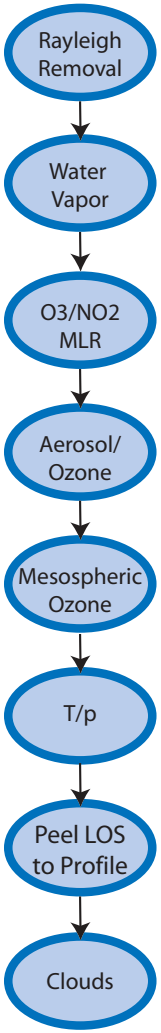


Species Algorithm Overview



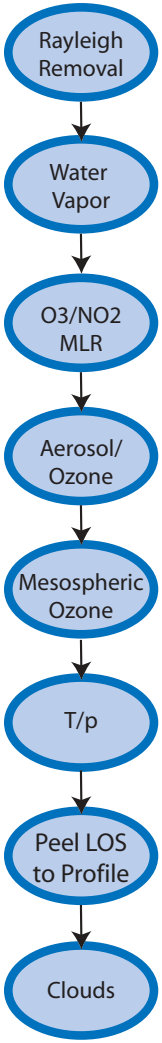
- NO_2, Ozone, & aerosol at 450, 521, 601, and 676 nm are corrected for the etaloning problem
- Water vapor and T/p retrievals both independently corrected for etaloning, other aerosol channels are not currently corrected for etaloning
- A 1-2-1 smoothing has been applied to most species at the LOS level (prior to peeling)

Water Vapor Retrieval



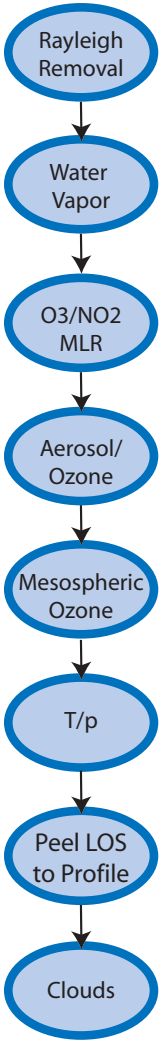
- Currently both the MLR (Multiple Linear Regression) and the Nonlinear Least Square (Marquardt-Levenberg) processes are being assessed for simultaneously retrieving water vapor and removing aerosol, ozone, and etaloning noise from the 940 nm measurements.
- Difficulties:
  - Etalon feature correlates with the shape of the water vapor feature
  - Relocation of two pixels to 920 nm and 971 nm did not improve the retrieval
  - Addition of 868 nm data provided good improvement

Multiple Linear Regression



- Infers column abundances of ozone, NO_2, and aerosol (as residual) using standard MLR routine (port of IDL REGRESS routine) and 29 pixel groups
- Approach
  - Included basic functions (EOF) for ‘etalon’ and correction for ‘tilt’ spectra (JMZ)

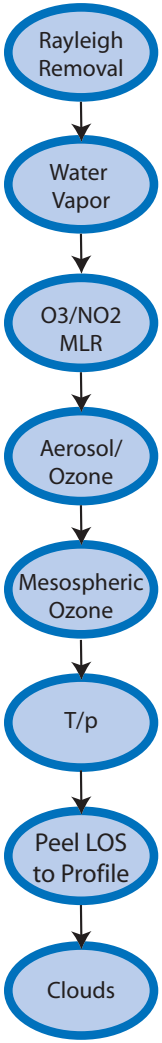
Aerosol/Ozone (Least Squares)



- Similar to SAGE II methodology
- Has not been modified from pre-launch version
- Uses least squares to infer ozone and aerosol (below 45 km) using a polynomial for interpolating aerosol to non-reported wavelengths
- Approach:

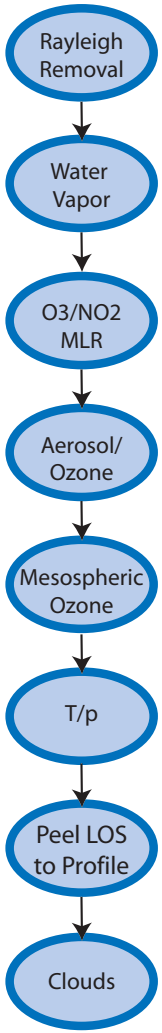
  Uses MLR corrected optical depth spectra

Mesospheric Ozone



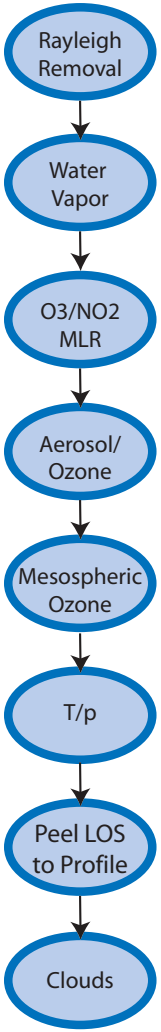
- Simple two-channel retrieval (290/385 nm) has been abandoned due to inadequate signal level for 385 nm measurements above 60 km altitude
- Using single channel at 290 nm with climatology for Rayleigh seems to work well
- Issues
  - High noise level for retrieval above 70 km altitude
  - Anomalous signal below 60 km
- Currently adding two additional channels at 285, 295 nm for improving the retrieval

Composite Ozone Profile



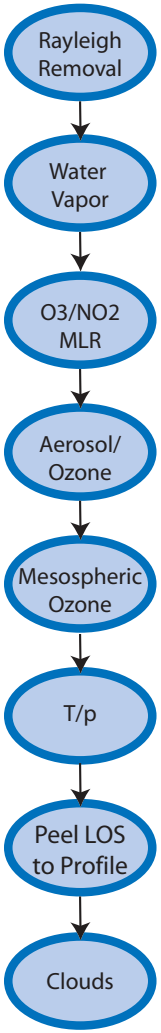
- A composite ozone profile (from cloud top to 100km altitude) is released as a standard data product
- The composite profile currently consists of
  - MLR Ozone cloud top-35 km
  - LS Ozone 35-50 km
  - Mesospheric ozone 50-100 km
- No mixing is performed
- Will be refined as individual products are improved

Temperature/Pressure Retrieval



- Uses a Marquardt-Levenberg (global fitting) technique to infer T/p using 14 pixel groups located across the oxygen A Band 758-771 nm
- Issues:
  - Modeling of etaloning effect is critical
  - High sensitivity to shift in pixel wavelength registration

LOS to Vertical Profile Peeling



- Onion peel algorithm is used to peel line-of-sight (LOS) profiles (O_3, NO_2, aerosol) to vertical profiles
- Added a 1-2-1 smoothing to the LOS profiles uniformly with altitude
  - Further refinements to smoothing are under study
- Differs from SAGE II algorithm which uses Twomey-Chahine and a 5-km smooth once extinction drops below $2.x10^{-5}$ km^{-1}

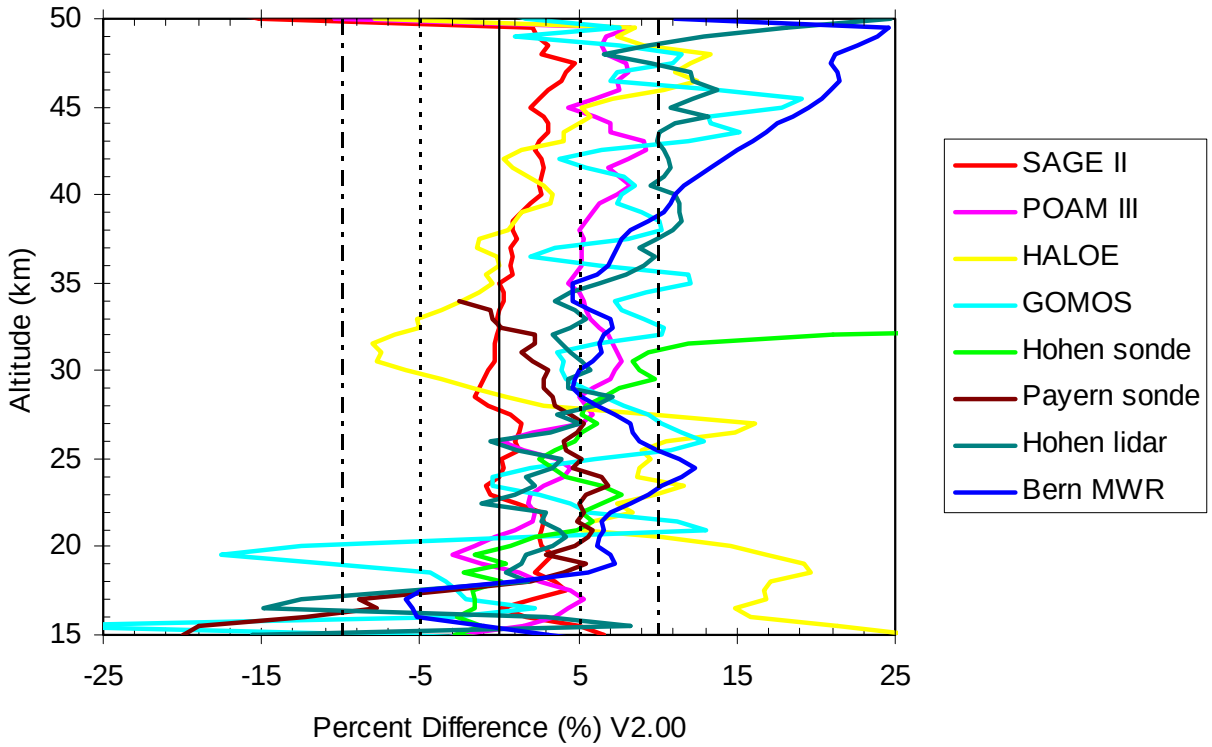
Lunar Data Inversion Algorithm

- Create optical depth curve with scan data and mean exoatmospheric lunar scan
- Filter optical depth curve to remove low frequency component
- Filter absorption cross sections
- MLR fit of filtered OD curve and cross sections

SAGE III Data Comparison

A brief summary

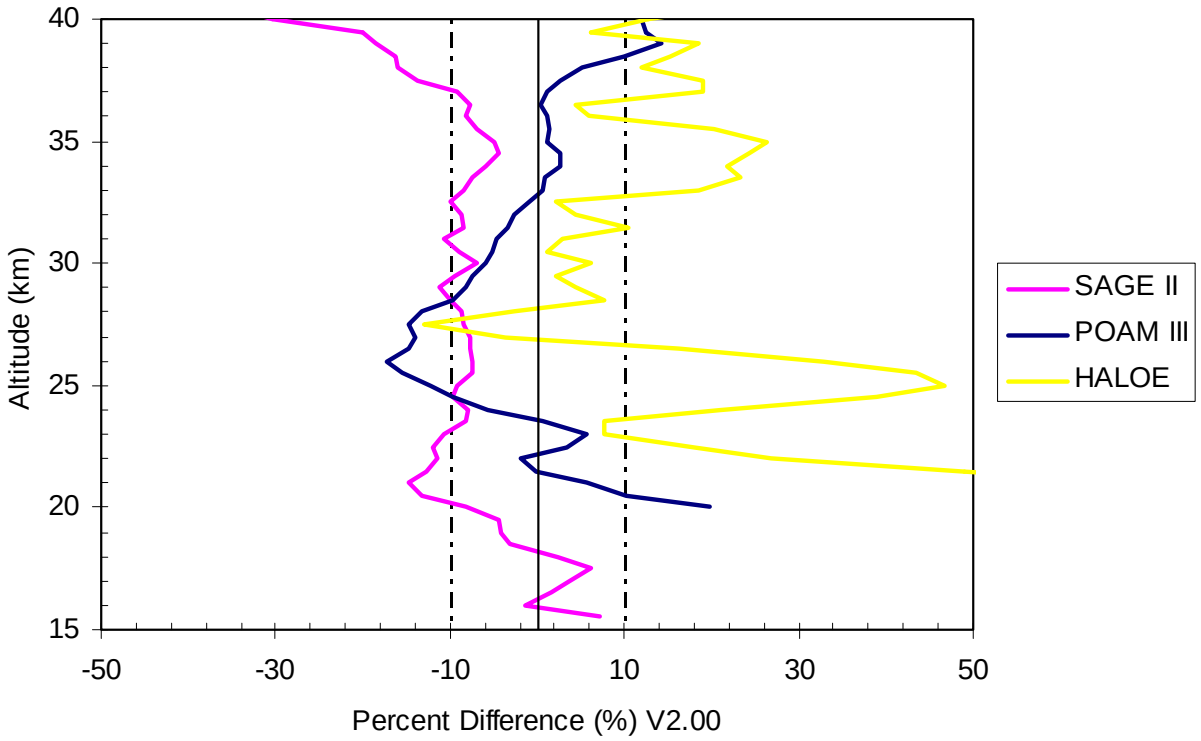
SAGE III data comparison summary (O_3)



ΔLat = 3-5 °
ΔLon = 10-25 °

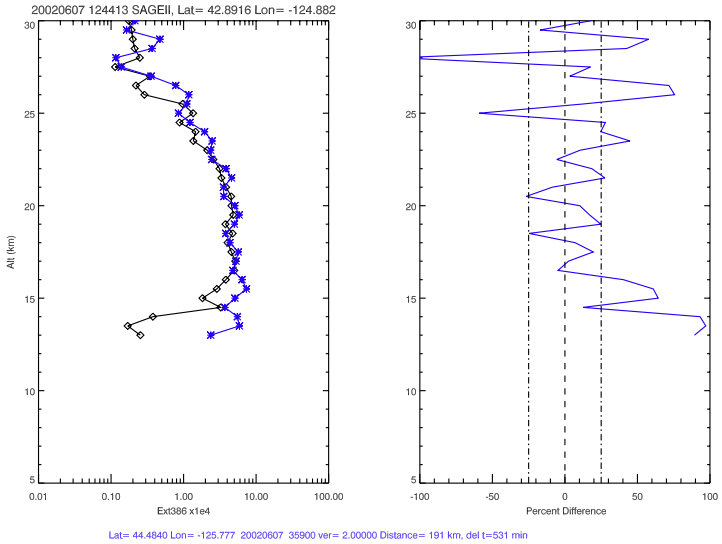
-Payern Ozonesonde data provided by Rene Stubi, Swiss Meteorological Institute, MCH
-Hohenpeissenberg Ozonesonde data provided by Wolfgang Steinbrecht, Deutscher Wetterdienst, DWD
-Hohenpeissenberg Lidar data provided by Hans Claude, Deutscher Wetterdienst, DWD
-Bern MWR data provided by Niklaus Kaempfer, University of Bern, UBERN

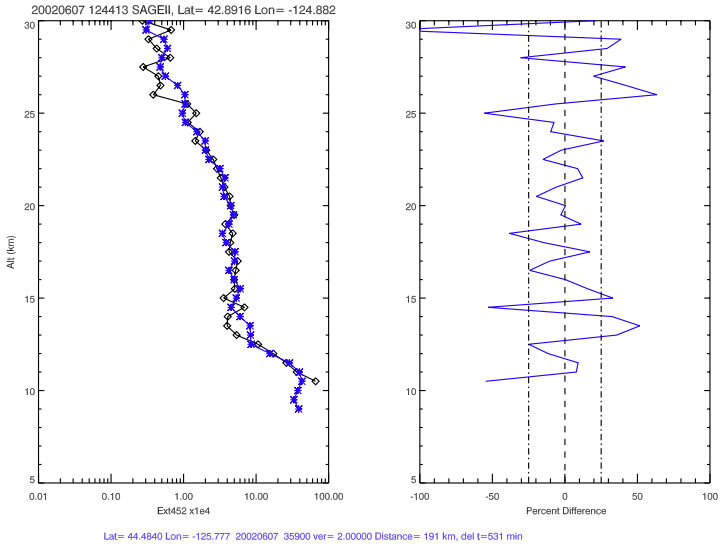
SAGE III data comparison summary (NO_2)

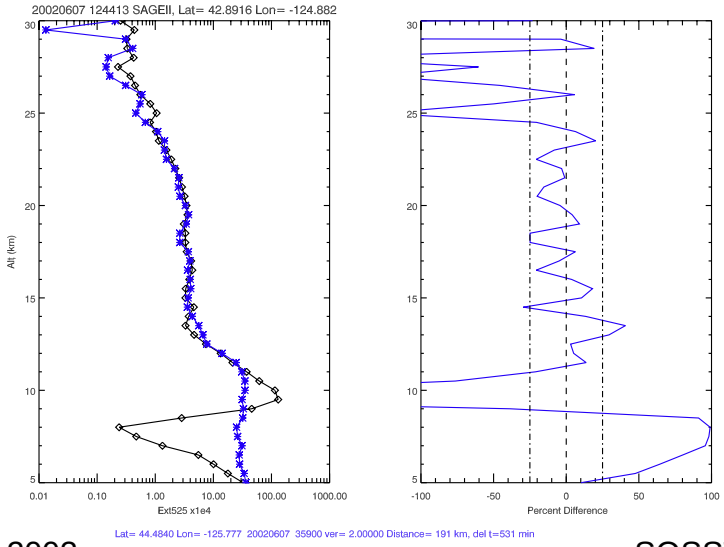


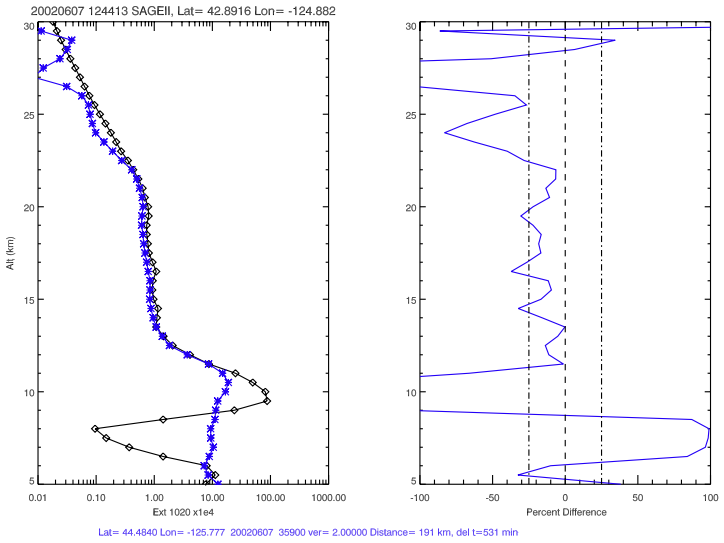
ΔLat = 3-5 °
ΔLon = 10-25 °

SAGE III SAGE II Aerosol Extinction









Future Plan

Lunar data, cloud data, and water vapor profile to be released this summer